

CASE REPORT

Isolated Metatarsal Artery Balloon Angioplasty for Toe Salvage in Critical Limb Ischemia

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Abstract

Purpose: To report a case of percutaneous balloon angioplasty (PTA) performed in the second metatarsal artery for treatment of a non-healing forefoot wound without proximal intervention.

Methods and Results: An 80-year-old diabetic woman with a 1.5 year history of a non-healing right second digit ulcer refractory to conservative management underwent a lower extremity arteriogram.

Angiography demonstrated unobstructed flow from the aortic bifurcation through to the pedal arch, with an isolated occluded segment in the second metatarsal artery wound supply. This was treated with 1.5 mm balloon angioplasty, with completion angiography demonstrating restored flow to the wound base. There were no procedural events and the wound completely healed after 9 months.

Conclusion: Isolated angioplasty of the arteries distal to the pedal arch may be technically feasible and clinically valuable in selected cases.

Key Words: *Balloon angioplasty; Metatarsal artery; Critical limb ischemia (CLI)*

Introduction

Patients with critical limb ischemia (CLI) often manifest with forefoot and digital ulceration or gangrene as a result of multilevel occlusive disease, including obstruction in the pedal arch and smaller digital branches that provide arterial flow directly to the wound [1-3]. Fundamentally, resolution of these wounds is governed by the concept of restoring adequate arterial “transmission” and “distribution” requiring sufficient patency of both big and small arteries for target tissue perfusion [4]. In this regard, studies have shown that below-the-ankle pedal arch angioplasty of patients with CLI significantly increases rate of wound healing [5,6]. Manzi et al. showed technical success and significant improvement in transcutaneous oxygen tension (TcPO₂) following pedal-plantar loop revascularization [7]. More recently, an evaluation of 257 patients from the Japanese RENDEVOUS Registry demonstrated that pedal arch reconstruction in addition to more proximal intervention significantly improved 12 month wound healing regardless of the severity of baseline infra-malleolar disease, representing

a potential paradigm shift when considering the targets and endpoints for endovascular tibiopedal procedures in chronic limb threatening ischemia [8].

While metatarsal artery access for proximal intervention has been reported by Palena et al., there is a paucity of literature describing intervention to restore patency of stenotic or occluded arteries beyond the pedal arch [1,2,5-7,9-11]. In this manuscript, we describe our initial experience performing isolated angioplasty of arteries distal to the pedal arch in patients with non-healing wounds.

Case Report

An 80-year-old woman with non-insulin dependent diabetes mellitus, peripheral arterial disease, dyslipidemia, and hypertension presented with a 1.5-year history of non-healing forefoot wound. The wound has persisted despite conservative management including wound care and medical management with aspirin, clopidogrel, simvastatin, glipizide and metformin.

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Physical exam revealed a Wagner Grade 2 intertriginous ulcer with punched out margins on the medial aspect of the second digit of the right foot. Capillary refill was diminished. Femoral and popliteal pulses were intact. The anterior tibial artery was dopplerable and posterior tibial artery was non-dopplerable. Pre-operative computed tomography angiography (CTA) ordered by the referring physician demonstrated no significant inflow disease, however, the tibial and pedal vessel findings were not reported. A diagnostic arteriogram with possible intervention was scheduled.

Antegrade right common femoral artery access was obtained using sterile technique and local anesthesia as well as moderate intravenous sedation. Intra-procedural heparin was routinely administered using a 5000 units/mL initial intravenous bolus with an additional 1000-2000 units/mL/hour at the operator's discretion without activated clotting time (ACT) monitoring. Angiography was performed demonstrating patency of the common femoral artery, common profunda femoral artery, superficial femoral artery, popliteal artery, and all three tibial vessels down to the ankle. The posterior tibial artery was patent into the common plantar segment with an incomplete pedal arch with absence of the distal lateral plantar artery as well as medial plantar artery. There was an arterial defect in the region of the wound on the medial aspect of the second toe.

Using digital subtraction angiography and road mapping, a micro catheter was advanced into the posterior tibial artery and anterior-posterior and lateral angiography performed demonstrated the second plantar metatarsal artery to be occluded (Figure 1A). This was successfully navigated with a 0.014-inch guidewire (Whisper; Abbot, Santa Clara, CA, USA) and micro catheter. Angioplasty of the selected metatarsal artery was performed using a 1.5 mm balloon (Figure 1B). Angioplasty was performed with slow, incremental increases in balloon inflation by 1 atm every 30-60s depending on the visual pattern of lesion effacement. The inflation was then maintained at the lowest pressure that resulted in full balloon expansion for 1-2 mins. Nitroglycerin was administered for spasm. Completion angiography demonstrated restored flow to the wound base and markedly improved forefoot perfusion through the pedal arch. The presence of a wound blush at the site of ulceration was considered an indication of adequate restored perfusion. The patient did not develop any immediate complications and was discharged to home (Figure 2).

Six-month follow-up demonstrated a well-healing wound with palpable, dopplerable pedal pulses. The wound healed completely after 9 months.

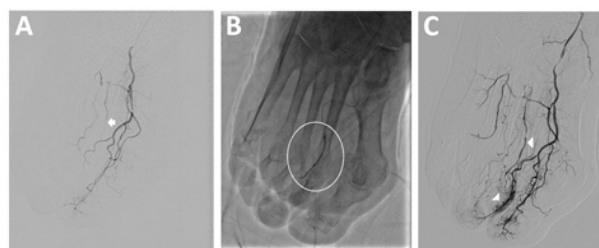


Figure 1) 80 y/o female patient with a second digit foot wound. Initial selective anterior tibial arteriography shows occlusion (white arrow) in the second plantar metatarsal artery (Figure 1A). Metatarsal angioplasty was performed with a 1.5 mm balloon (Figure 1B). Completion angiography (Figure 1C) shows improved luminal caliber in the treated segment with markedly improved distal perfusion (arrowheads) and wound blush.

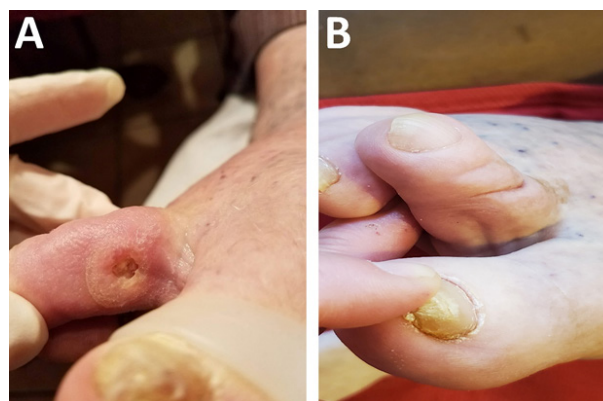


Figure 2) Pre-operative (A) and post-operative (B) second digit wound images following isolated metatarsal artery balloon angioplasty. Print color requested.

Discussion

Endovascular therapy is often the primary treatment strategy for patients with CLI to prevent amputation due to lower extremity arterial occlusive disease [3,6,12]. More recently, there is emerging data suggesting that pedal arch angioplasty (PAA) in addition to inflow intervention confers amputation prevention benefit [2,5-7,13,14]. However, the concept of restoring adequate uninterrupted arterial transmission for wound healing may in some cases require even more distal interventions, particularly in diabetics and chronic kidney disease patients who have impaired collateralizations. In the present case, there was non-occlusive atherosclerotic disease in the arterial inflow and the obstruction in the occluded metatarsal artery was either de novo atherosclerosis or embolic in etiology. It is possible that this was a case of cholesterol embolization syndrome and prostacyclin therapy could have been considered, although it was not available at the time [15]. Since the digital arterial disease was focal rather than diffuse, the likely cause was atherosclerotic.

Our early experience supports the concept that very distal and wound artery directed angioplasty may result in wound healing in patients with isolated obstruction distal to the pedal arch. A larger series of 12 patients in our practice who had very distal angioplasty in

addition to tibial or pedal arch interventions found that complete healing of the foot wound occurred in 8 of 9 patients at one-year follow-up period (88.9%), with a mean time wound resolution time of 10.0 ± 4.4 months. A limitation of the present study was the lack of quantitative assessments of perfusion such as TcPO₂, toe brachial index (TBI) and photoplethysmography (PPG). These tools can provide valuable information about the effectiveness of interventions and will be utilized in future cases. Although Arslan et al. documented a case of arterial perforation of the third dorsal metatarsal artery following balloon rupture and subsequent coiling to control bleeding to control bleeding [16], no complications

requiring additional procedures have occurred in our series. This experience suggests that there may be added clinical value to treating very distal arteries in patients with persistent forefoot or digital wounds even after successful more proximal intervention.

Conclusion

Isolated angioplasty of the metatarsal artery was feasible in a case of a distal non-healing foot wound. Further studies are required to assess benefit as an adjunct to proximal intervention.

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